Pixel correlation on flat image

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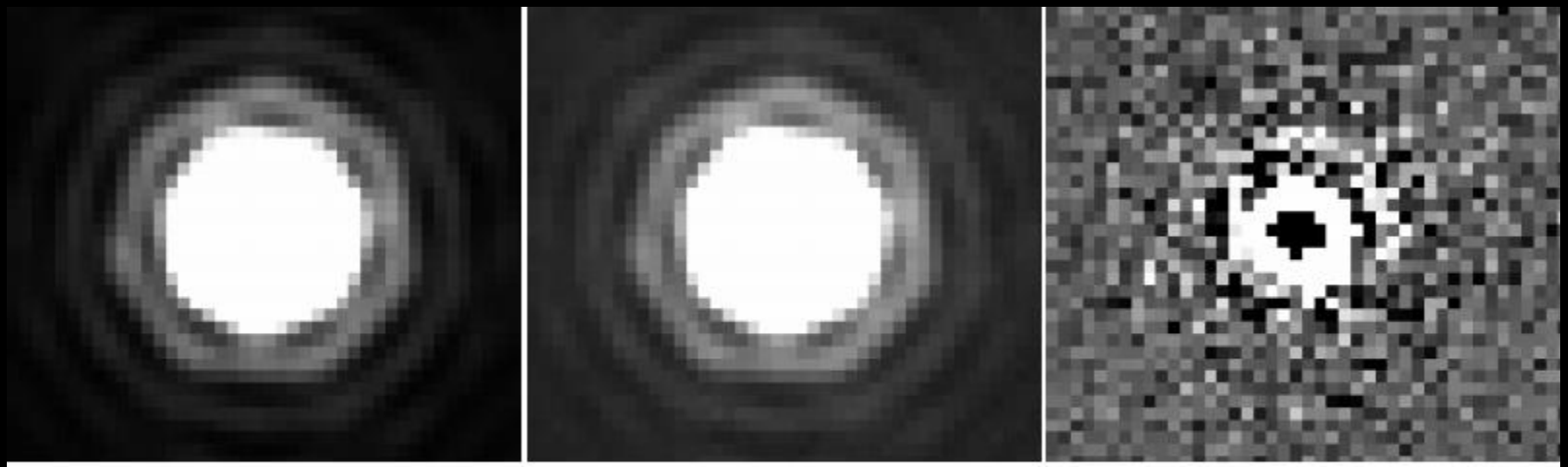
Our study is how BF effect makes bias in cosmic shear measurement and in constraining the cosmological parameters.

For this purpose, we need BF model for re-producting BF effect for arbitrary PSF shape and flux.

The first step of this study is measuring BF effect.

Brighter-Fatter measurement : spot

There are 2 ways to measure BF effect, one is measuring size of spots with different exposure times. Spots with longer exposure time has larger size due to BF effect. We can measure BF effect easily by this way, but we can measured BF effect only for the spot shape. It is not easy to make BF model for arbitrary shapes, because BF is not simple convolution.



(a) 200-s exposures (b) 20-s exposures (c) subtraction (a)-(b)
A. Guyonnet et al. 2014

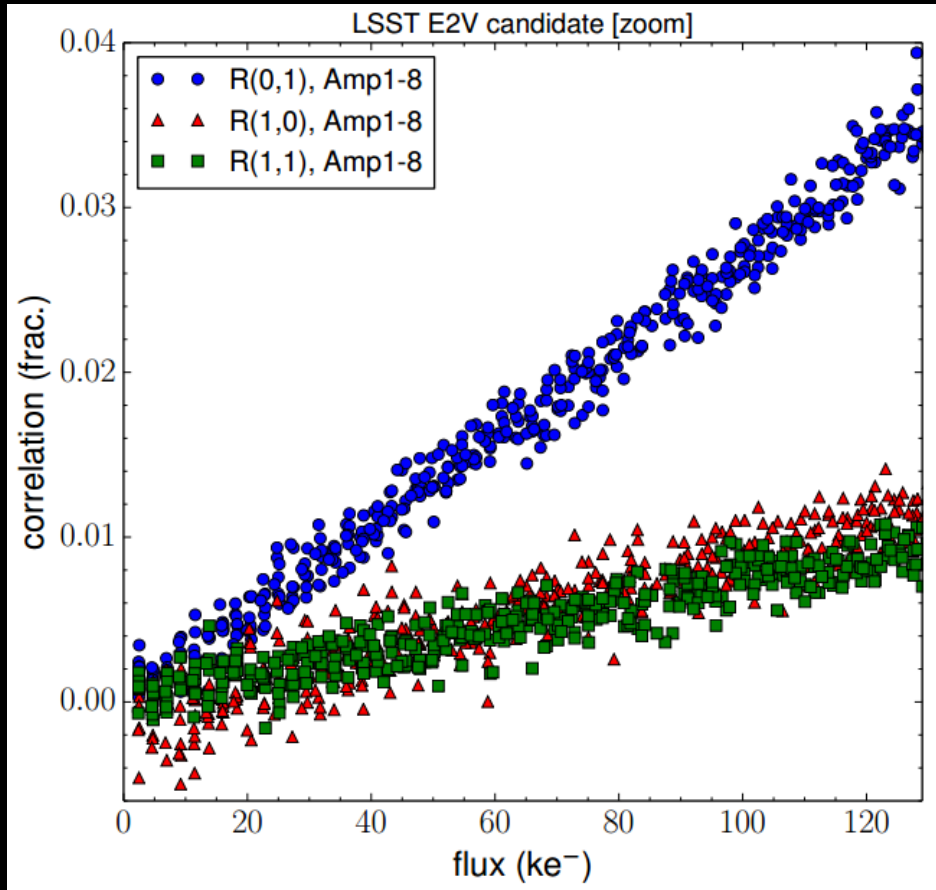
Brighter-Fatter measurement

Another one is measuring correlations of flat image. Flat images have Poisson noise and the noise peak is one pixel size, so we can measure BF effect for one pixel peaks. However, typical scale of the peaks is sqrt(N), e.g. if flat image has 90ke-, we can measure BF effect for peaks under 1ke-.

Previous studies by Guyonnet.

Correlation of all pixels between neighbor pixels, so this is not correlation for each peak count.

-> We tried to measure correlation for each peaks.



A. Guyonnet et al. 2014

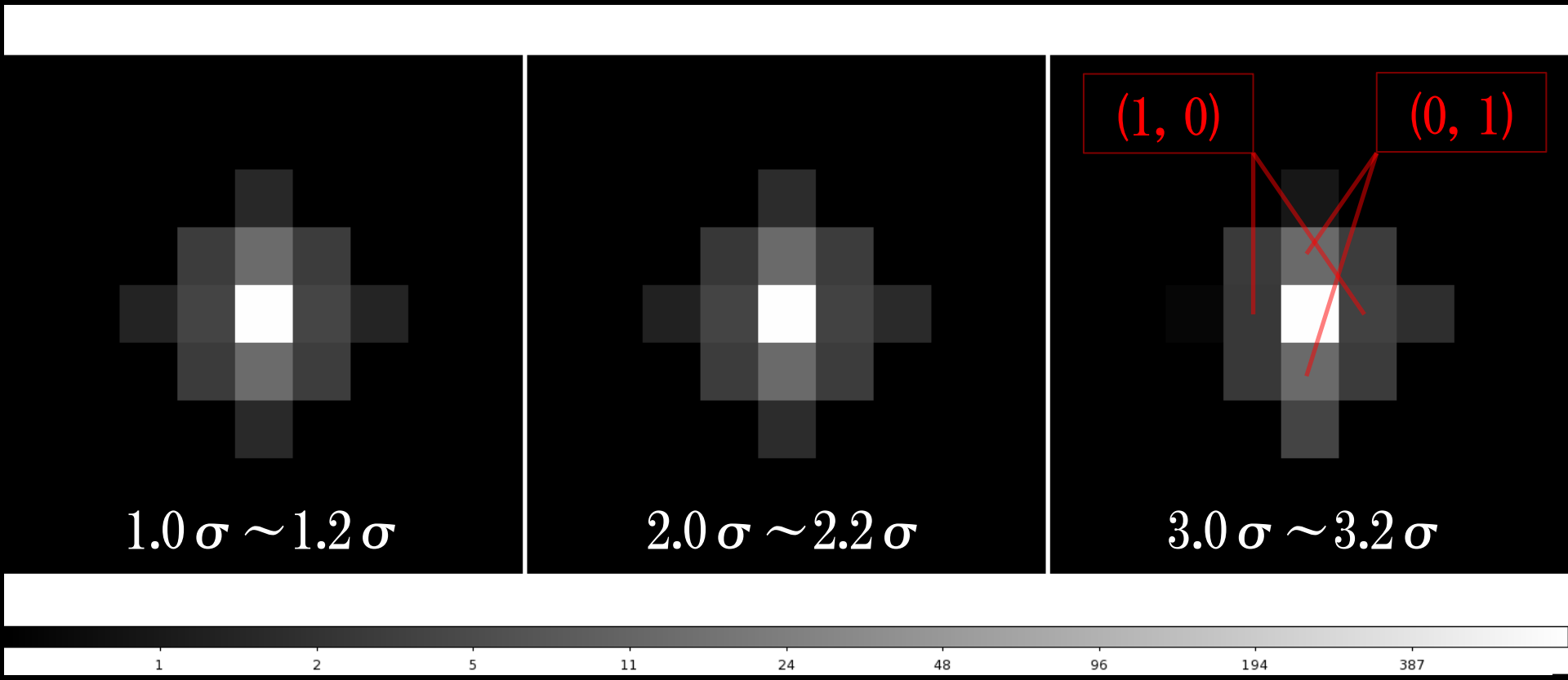
Data

We measured from three e2v and two ITL flat data sets with different mean flat count.
The gains of some of data set are unknown.

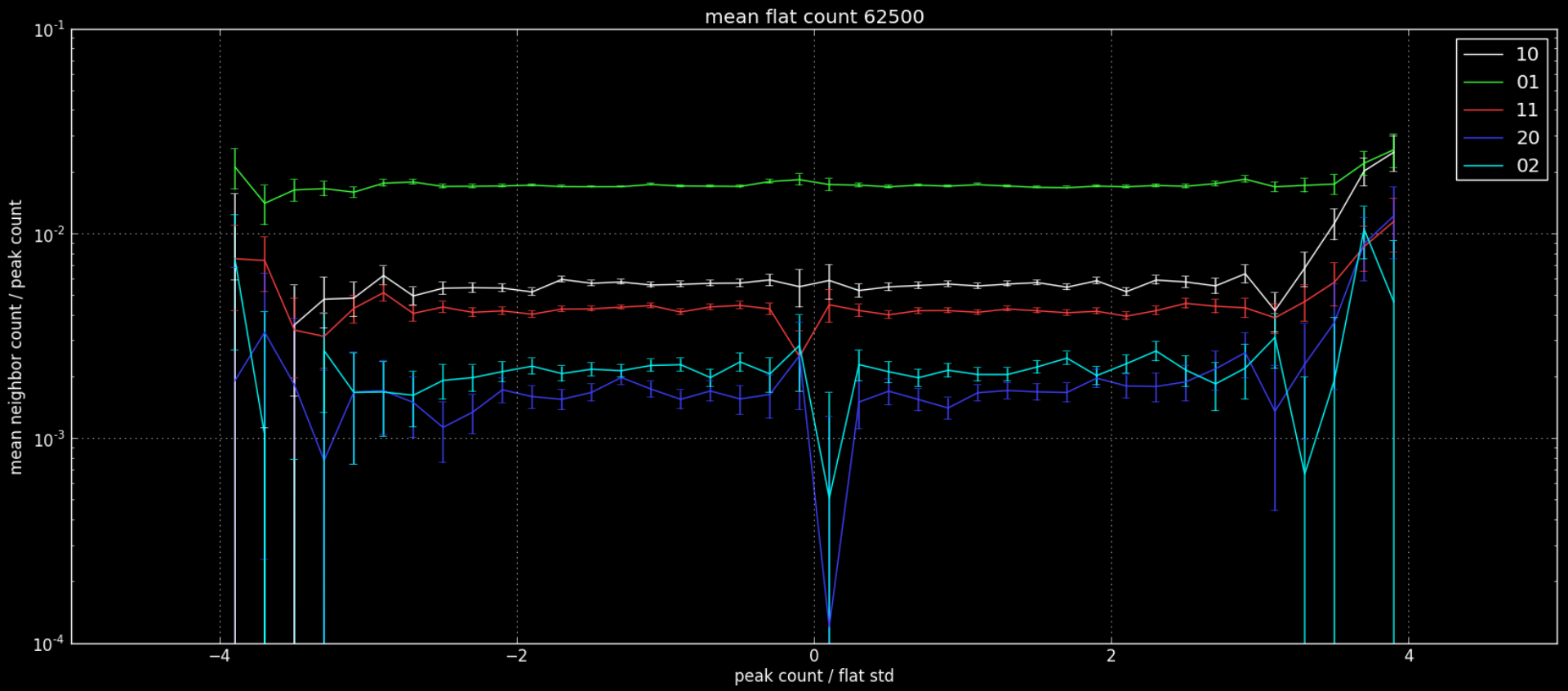
Type	Name	N shots	Flat count	Std
e2v	112-04	25	62500e-	250e-
e2v	13421	25	10000e- ?	100e-?
e2v	13455	25	30000e-	175e-
ITL	113-04 5ke-	30	5000e- ?	?
ITL	113-04 50ke-	30	50000ke- ?	?

Method

Stacking peak images with surrounding pixels for each peak counts (0.2n x sigma), then measure mean count of neighbor pixels.
Stacked neighbor pixels only |n| + |m| <= 2 for (n, m).



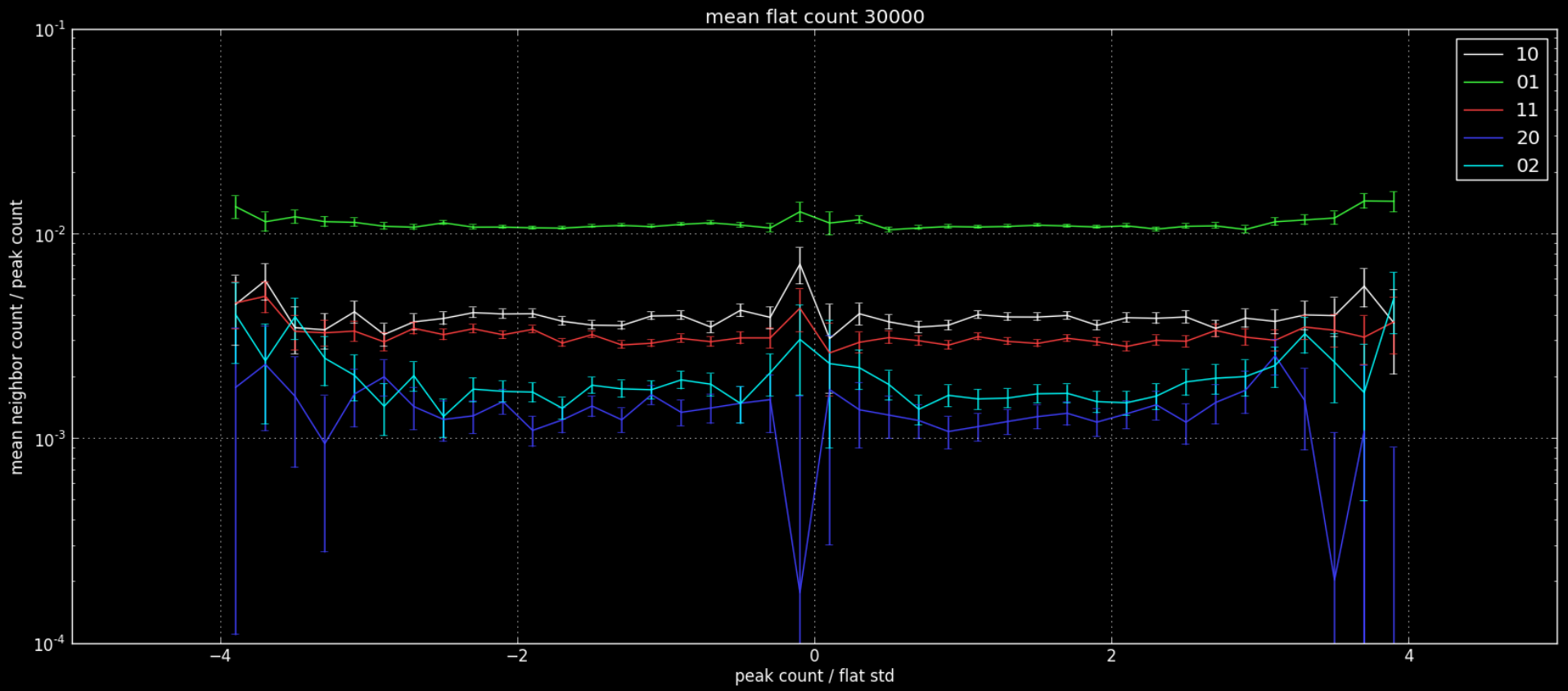
Result



Correlation on 112-04

0.6% for (1, 0), 1.7% for (0, 1), 0.4% for (1, 1)

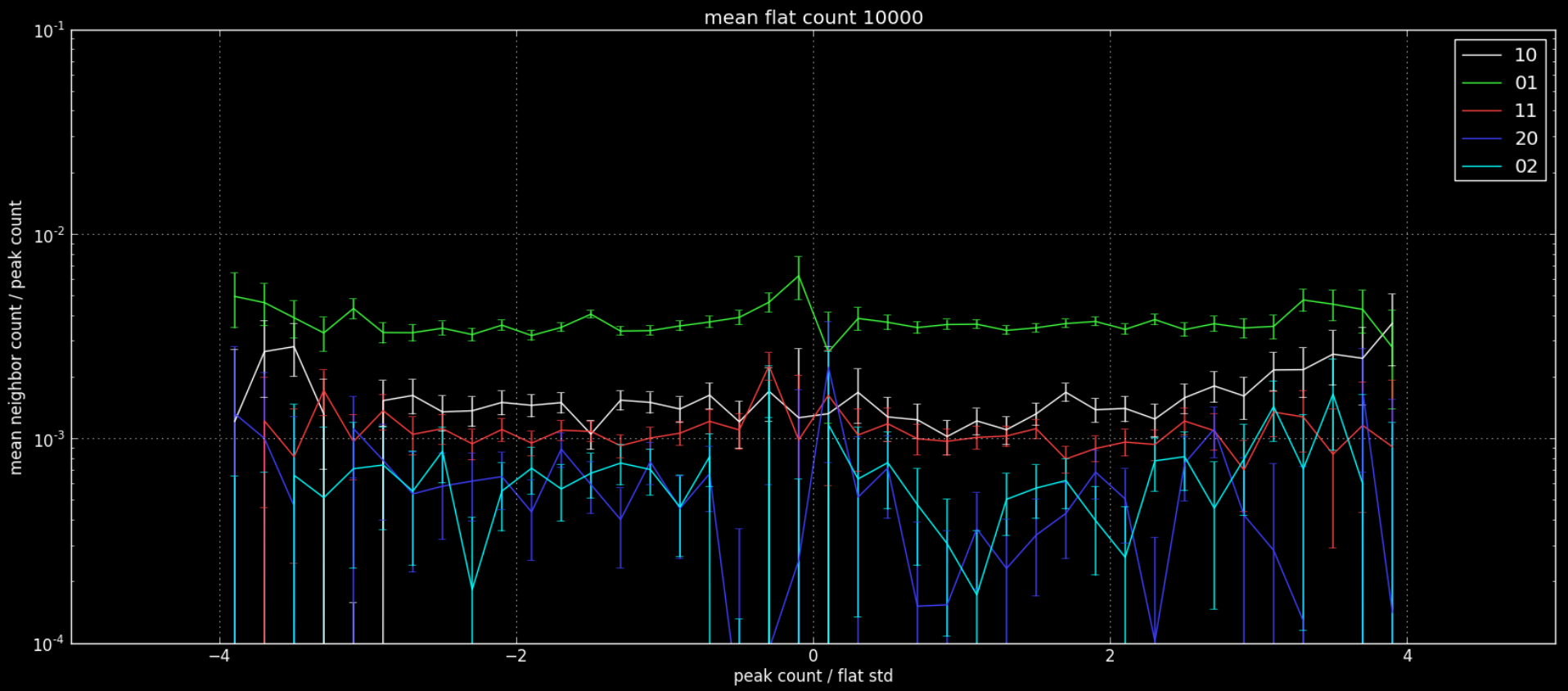
Result



Correlation on 13455

0.4% for (1, 0), 1.1% for (0, 1), 0.3% for (1, 1)

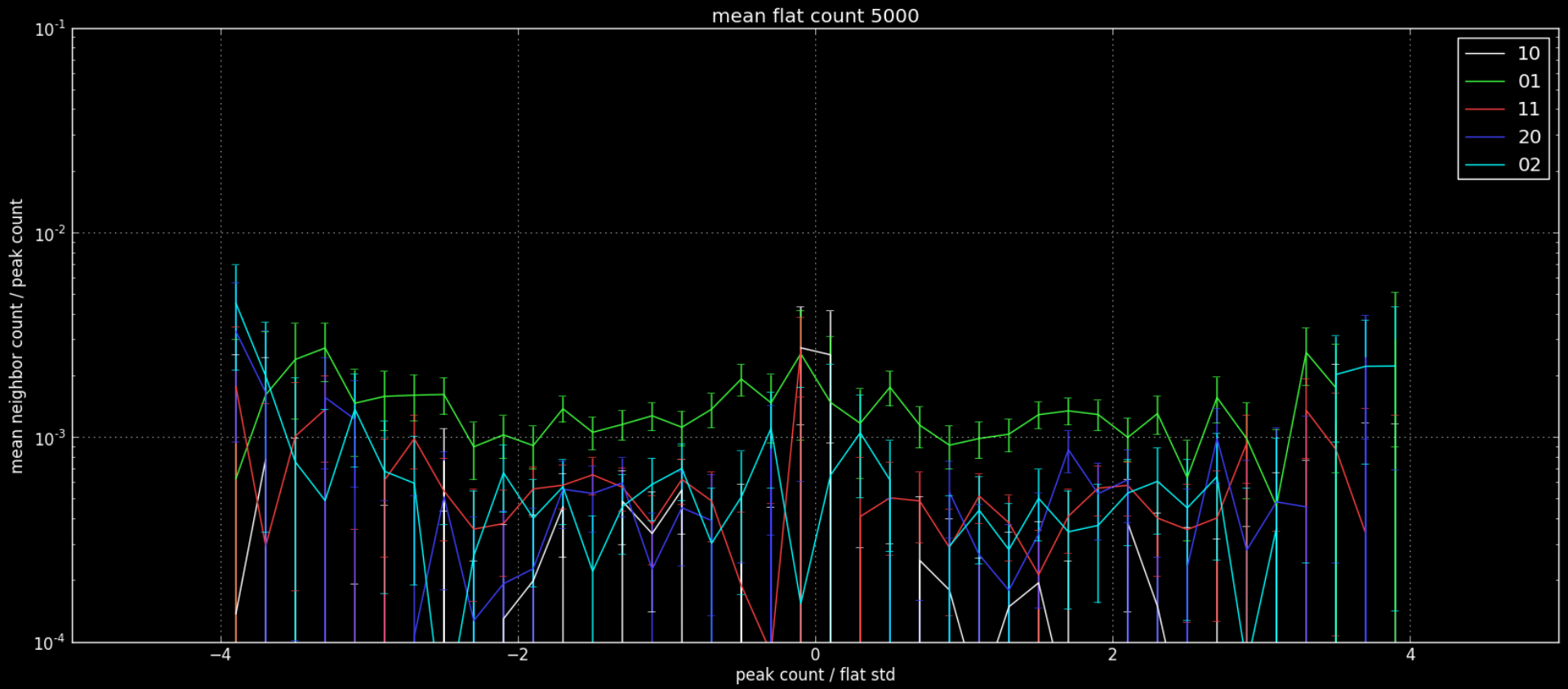
Result



Correlation on 13421

0.1% for (1, 0), 0.3% for (0, 1), 0.1% for (1, 1)

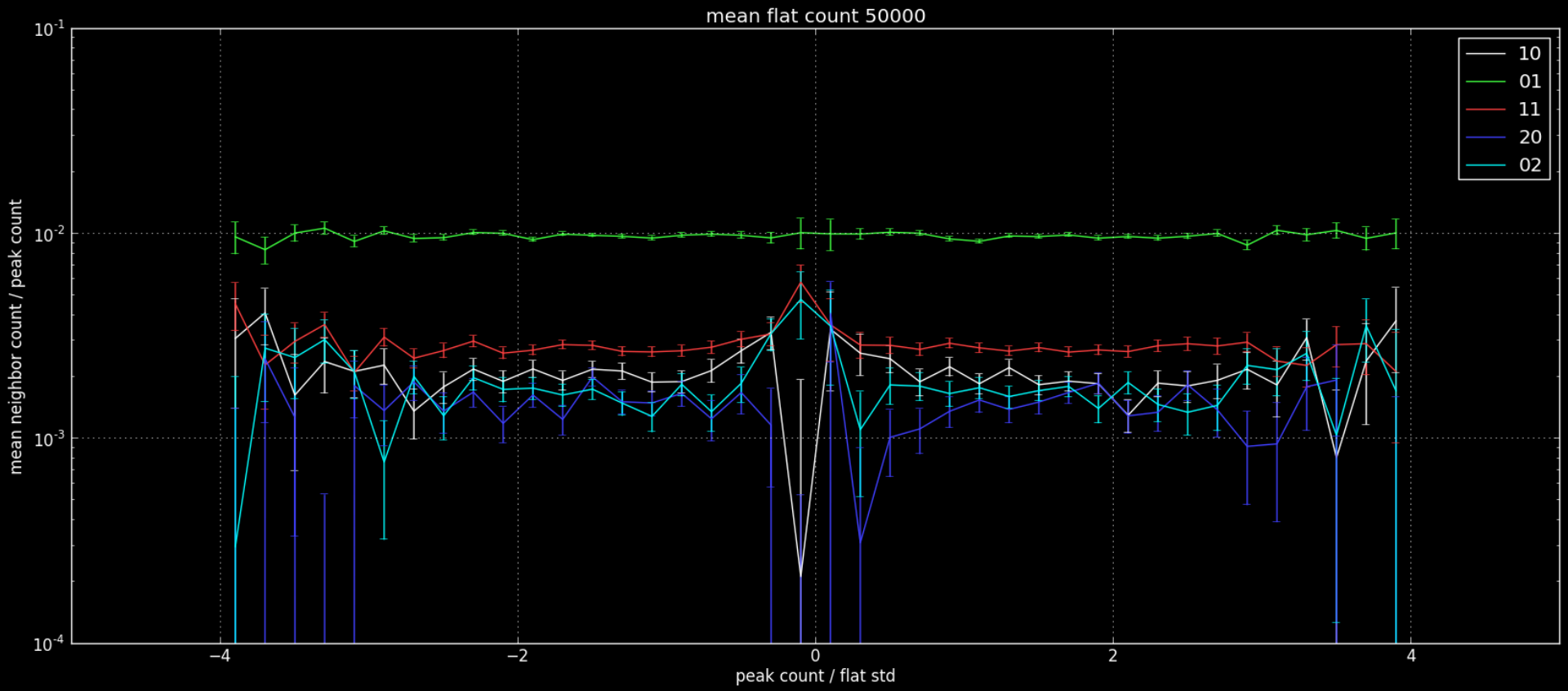
Result



Correlation on 113-04 5ke-

0.0% for (1, 0), 0.13% for (0, 1), 0.04% for (1, 1)

Result

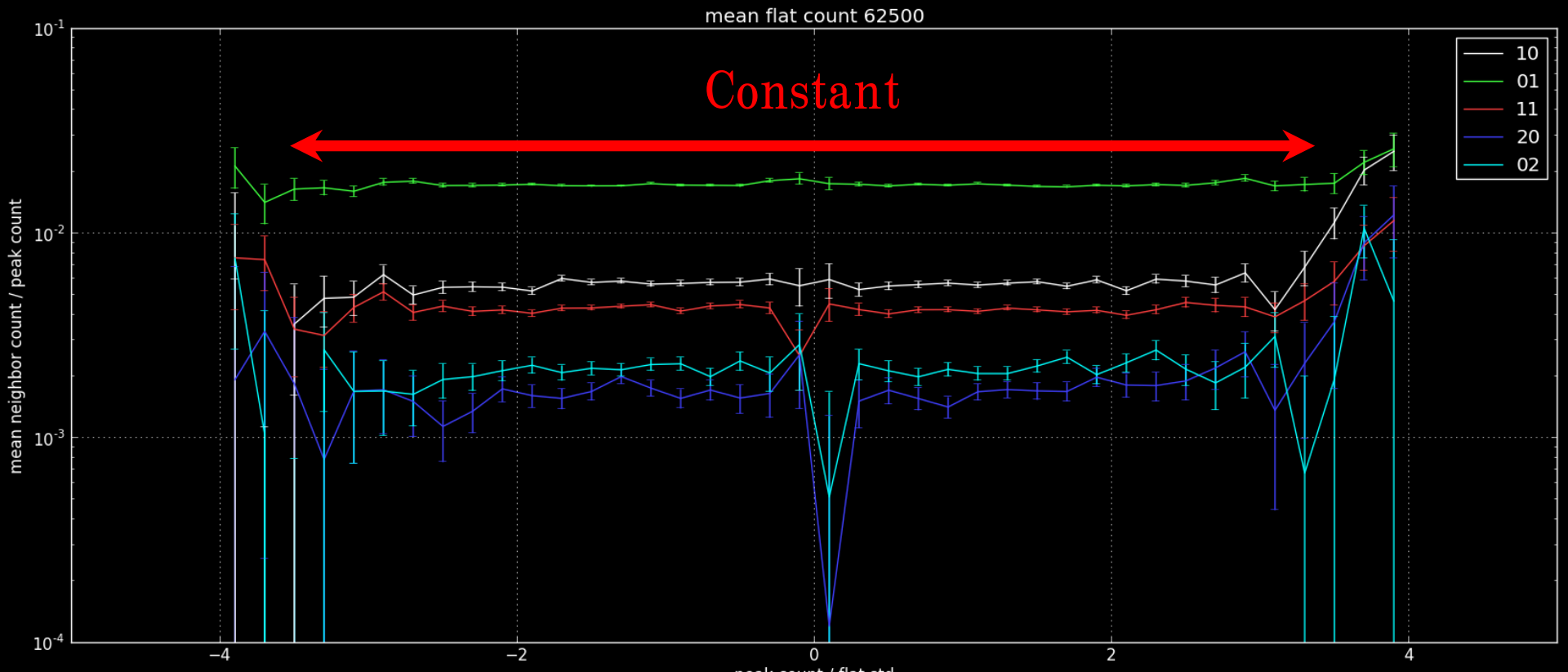


Correlation on 113-04 50ke-

0.2% for (1, 0), 1.0% for (0, 1), 0.3% for (1, 1)

Summary

There is correlation between neighbor pixels, but it does not depend on peak counts.
So, the correlation is not from BF effect, but just fatter effect, or BF effect is too small to see from such small peaks.



Summary

What happened ?

One idea which can explain this result is diffusion

> Diffusion affects for all electrons independently on peak count.

> Width of diffusion is depend on VBB, but flat count canceled out VBB partially.
-> Larger flat count makes lower effective VBB.
-> Lower VBB makes wider diffusion.
-> Wider diffusion makes stronger correlation for neighbor pixels.

Diffusion could be able to make correlation for neighbor pixels which does not depend on peak count but mean flat count.

Future works

Studying diffusion on LSST CCD
-> checking these results are consistent or not.

Measuring BF from the spot data.
-> Making BF model for re-producting BF for arbitrary PSF.